



Assessment of the impact of climate shifts on malaria transmission in the Sahel

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Abstract:

Climate affects malaria transmission through a complex network of causative pathways. We seek to evaluate the impact of hypothetical climate change scenarios on malaria transmission in the Sahel by using a novel mechanistic, high spatial- and temporal-resolution coupled hydrology and agent-based entomology model. The hydrology model component resolves individual precipitation events and individual breeding pools. The impact of future potential climate shifts on the representative Sahel village of Banizoumbou, Niger, is estimated by forcing the model of Banizoumbou environment with meteorological data from two locations along the north-south climatological gradient observed in the Sahel--both for warmer, drier scenarios from the north and cooler, wetter scenarios from the south. These shifts in climate represent hypothetical but historically realistic climate change scenarios. For Banizoumbou climatic conditions (latitude 13.54 N), a shift toward cooler, wetter conditions may dramatically increase mosquito abundance; however, our modeling results indicate that the increased malaria transmissibility is not simply proportional to the precipitation increase. The cooler, wetter conditions increase the length of the sporogonic cycle, dampening a large vectorial capacity increase otherwise brought about by increased mosquito survival and greater overall abundance. Furthermore, simulations varying rainfall event frequency demonstrate the importance of precipitation patterns, rather than simply average or time-integrated precipitation, as a controlling factor of these dynamics. Modeling results suggest that in addition to changes in temperature and total precipitation, changes in rainfall patterns are very important to predict changes in disease susceptibility resulting from climate shifts. The combined effect of these climate-shift-induced perturbations can be represented with the aid of a detailed mechanistic model.

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Resource Description

Exposure :

weather or climate related pathway by which climate change affects health

Ecosystem Changes, Meteorological Factors, Meteorological Factors, Precipitation, Solar Radiation, Temperature

Temperature: Fluctuations

Geographic Feature:

resource focuses on specific type of geography

Climate Change and Human Health Literature Portal

None or Unspecified, Urban

Geographic Location: ☒

resource focuses on specific location

Non-United States

Non-United States: Africa

African Region/Country: African Region

Other African Region: Sahel region

Health Impact: ☒

specification of health effect or disease related to climate change exposure

Infectious Disease

Infectious Disease: Vectorborne Disease

Vectorborne Disease: Mosquito-borne Disease

Mosquito-borne Disease: Malaria

Mitigation/Adaptation: ☒

mitigation or adaptation strategy is a focus of resource

Adaptation

Model/Methodology: ☒

type of model used or methodology development is a focus of resource

Exposure Change Prediction

Resource Type: ☒

format or standard characteristic of resource

Research Article

Timescale: ☒

time period studied

Short-Term (

Vulnerability/Impact Assessment: ☒

resource focus on process of identifying, quantifying, and prioritizing vulnerabilities in a system

A focus of content